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(19) (CA) **CANADIAN PATENT** (12)

(54) Material Conveying Apparatus

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ABSTRACT

**MATERIAL CONVEYING APPARATUS**

A device for the continuous introduction of bulk material into a pneumatic conveying conduit comprising a first vessel (2) gravity fed with material through a valved top inlet (6) from a hopper (1), and a second vessel (3) connected via line (17) to the first vessel (2). When required, vessel (3) is topped up with material forced along line (17) from vessel (2), and vessel (3) dispenses the material via controlled valve (11) into conduit (14) which thus is connected to compressor (16). The low level top inlet valve (6) of vessel (2) enables the system to be installed in a location where there is a height limitation.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A device for the introduction of bulk material into a pneumatic conveying conduit comprising a first vessel for the material, having a top material inlet valve and a material outlet, a supply means for compressed gas, and a second vessel for the material, having an outlet to the conveying conduit including means to regulate the flow of material into the latter, the material outlet of the first vessel being connected by a valved conduit to the second vessel with pneumatic conveying means for pressurising the first vessel thus to transfer material from the first vessel to re-fill the second vessel when required to ensure a continuous flow of material into the conveying conduit, the first vessel being situated adjacent the second vessel and connected to a bulk storage means which has its outlet to the first vessel at a level below the level of the top of the second vessel.
2. A device according to claim 1, wherein the means to regulate the flow of material into the conveying conduit is a gravity flow device with a feed-back control system.
3. A device according to claim 1, in which the means for regulating material flow into the conveying conduit is a gravity flow device with a feed-back control system, said device being connected to control means including pressure sensing means thus to adjust the material flow dependent upon a predetermined pressure in the conduit.
4. A device according to claim 1, 2 or 3, including means in the base region of said first vessel to fluidise the material therein and wherein said supply means for compressed gas is connected to said conveying conduit.
5. A device according to claim 1, 2 or 3, including a balance line between the conveying conduit and said second vessel to ensure equalised pressures therein.

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6. A device according to claim 1, 2 or 3, including a plurality of control valves to cause material to be conveyed from said first to said second vessel when the level of material in the latter falls below a predetermined level.

7. A device according to claim 1, 2 or 3, wherein said first vessel is gravity fed with material from said bulk storage means via said top material inlet valve.

8. A device according to claim 1, 2 or 3, wherein said first vessel includes level sensing means to cause operation of said top material inlet valve when the material in said first vessel falls below a predetermined level.



## MATERIAL CONVEYING APPARATUS

THIS INVENTION relates to a device for the continuous introduction of bulk material into a pneumatic conveying conduit.

5       The invention is intended for use in areas where there is a height limitation between the outlet of the bulk storage and ground level. Present continuous feed devices which can operate with low height are ejectors, rotary feed valves or rotary screw pumps. They have the disadvantages of, a) limitation on operating pressures, b) high wear  
10       rates of the moving parts, and, c) high power consumption for the moving parts.

      Blow tanks, which are a conventional method of pneumatic transport could also be used, but because of the low height limitations the blow tanks would be quite small  
15       and because of their cyclic manner would not provide the conveying rates afforded by the constant feed devices previously described.

      There are known methods of using two blow tanks situated side-by-side and working on alternative cycles to  
20       provide a continuous material input into the conveying conduit, however, this does not resolve the height problem since the inlets for both vessels are by necessity positioned some distance apart and chutes from one outlet



on the feeding bunker to both inlets would require considerable height to achieve flow by gravity.

Known principles of regulating the material flow continuously into the conveying conduit, are rotary valve  
5 feeders, screw feeders, and gravity flow devices with pressure feed back signals to regulate material flow in accordance with conveying conduit pressure.

The above known methods are capable of feeding materials into the conveying conduit continuously using  
10 pressure vessels as material pressure locks by locating one vessel on top of the other vessel with valves between each vessel and a valve on the inlet of the top vessel to allow material to gravity flow first into the top vessel and then by gravity into the bottom vessel which contains the  
15 material feeding device. This bottom vessel is kept under constant pressure, similar to that of the conveying conduit, and the top material and air inlet valves operated in a manner which prevents pressure escape but allows material to gravitate into the feeding vessel. However,  
20 the major problem with this arrangement is that it is a relatively tall assembly and can therefore not be used in a system where there is a height limitation.

The present invention is based on the provision of two vessels adjacent to one another, one acting as a "lock

vessel", the other as a "feeding vessel". The "lock vessel" is smaller than the "feeding vessel", and is used on a cyclic basis to replenish material which is continuously discharged from the feeding vessel. Since the lock vessel has only to convey material the short distance between the two vessels, it can cycle frequently and hence be of a relatively small volume in relation to the amount of material being conveyed through the system. The actual discharge rate from the feeding vessel is controlled by the conveying conduit pressure. The objective is to maintain a constant set line pressure by the regulation of material flow into the conveying conduit.

According to the invention, there is provided a device for the introduction of bulk material into a pneumatic conveyor conduit comprising a first vessel having a top material inlet valve and a material outlet, a supply means for compressed gas, and a second vessel having an outlet to the conveying conduit including means to regulate the flow of material into the latter, the material outlet of the first vessel being coupled to the second vessel such that material is pneumatically conveyed thereto from the first vessel to re-fill the second vessel when required to ensure a continuous flow of material into the conveying conduit, the first vessel being situated adjacent the second vessel, and connected to a bulk storage means which has its outlet to the first vessel at a level below the level of the top of the second vessel.



Thus the device may be used in a system where there is a height limitation. The means to regulate the flow of material into the conduit may typically be a rotary valve feeder, a screw feeder or a gravity flow device with  
5 a pressure feed back system.

Preferably, the means for regulating material flow into the conveying conduit is connected to pressure sensing means and to control means to adjust the material flow dependent upon the pressure in the conduit.

10 An example of the device in accordance with the invention will now be described by way of example only with reference to the accompanying schematic drawing.

A bulk feeding hopper 1 is situated with its outlet over the top inlet of a first vessel 2 which is at  
15 low level above the ground 4. Air from a blower 16 picks up material falling from a second vessel 3 by gravity through a valve 11 which is regulated by a control system 12 including pressure sensing means to allow the correct amount of material into a conveying conduit 14 dependent  
20 upon a constant pre-determined pressure in the part of the conduit indicated by reference P.

Vessel 3 holds material, and the pressure in the

top of the vessel is kept the same as at P by a balance line 10. When material in vessel 3 is above a level sensor 9, two valves 18 and 15 are held closed. When the level of material falls below sensor 9, two valves 6 and 7 are opened allowing vessel 2 to fill to its level sensor 8. Then valves 6 and 7 close and valve 15 is opened to admit pressurised air into the base of vessel 2 until the pressure is equal to that in vessel 3 before valve 18 is opened. The pressure differential caused by a restriction 13 in conduit 14 causes material to be pneumatically conveyed from vessel 2 through conduit 17 into vessel 3. When transfer of material is complete valves 18 and 15 are closed. During transfer from vessel 2 to vessel 3 the air used for conveying vents through balance pipe 10. Membrane 5 in the base of vessel 2 is a fluidising membrane or similar device to aerate the product before conveying it to vessel 3. The cycle is repeated when the material level falls below level sensor 9.

